International Journal of Cardiology 181 (2015) 188–192

Contents lists available at ScienceDirect

International Journal of Cardiology

journal homepage: www.elsevier.com/locate/ijcard

Presence and extent of coronary artery disease as predictor for AF recurrences after catheter ablation: The Leipzig Heart Center AF Ablation Registry ☆

Jelena Kornej *, Gerhard Hindricks, Arash Arya, Philipp Sommer, Daniela Husser, Sascha Rolf, Andreas Bollmann

Leipzig University Heart Center, Department of Electrophysiology, Germany

ARTICLE INFO

Article history:
Received 20 October 2014
Received in revised form 1 December 2014
Accepted 12 December 2014
Available online 13 December 2014

Keywords:
Atrial fibrillation
Catheter ablation
AF recurrences
Coronary artery disease

ABSTRACT

Background: Occlusion of the right coronary artery (RCA) may promote atrial fibrillation (AF) by creating a right atrial substrate. However, the presence and extent of coronary artery disease (CAD) is usually not considered to tailor AF ablation strategies. This study was aimed to analyze the possible association between the presence and extent of CAD and rhythm outcomes of *left-atrial* AF catheter ablation.
Methods: 1310 patients (60 ± 10 years, 67% males, 63% paroxysmal AF) from The Leipzig Heart Center AF Ablation Registry undergoing *de novo* AF catheter ablation were included. CAD was defined as stenosis ≥ 50% in the left main coronary artery and ≥70% in one or several of the major coronary arteries. AF recurrences were defined as any atrial arrhythmia lasting >30 s and occurring within the first week (early recurrences, ERAF) or between 3 and 12 months (late recurrences, LRAF) after ablation and were assessed with serial 7-day Holter ECG.
Results: 152 patients (11.6%) had significant CAD; 89 (59%) had one, 35 (23%) two and 28 (18%) three vessel disease; 72 (47%) patients had RCA involvement. Occurrence of AF recurrences was comparable in CAD ($p = 0.625$ and 0.568 for ERAF and LRAF, respectively). Among patients with CAD, neither the location (RCA versus non-RCA) nor the extent of CAD (single versus multiple vessel disease) was associated with rhythm outcomes after AF catheter ablation (all $p > 0.05$).
Conclusion: The presence and extent of CAD seem not to impact on rhythm outcome of AF catheter ablation in the entire cohort.

1. Introduction

Catheter ablation targeting the pulmonary veins has been reported as potential curative method for atrial fibrillation (AF) treatment since the late 1990s [1]. As techniques and technologies have improved, catheter ablation has became an effective treatment strategy for patients with drug-refractory AF with continuous escalation of its popularity [2]. Of note, recent ESC guidelines suggested to include catheter ablation even as a first line therapy for specific groups of AF patients [3].

Although catheter ablation is superior to antiarrhythmic drugs [4], up to 50% of AF patients suffer recurrences within the first year [5]. On the one hand, AF recurrences are associated with impaired quality of life, on the other hand, they are also related to poor clinical outcomes such as increased morbidity and mortality due to cardio- and cerebrovascular events [2,6].

Several studies were performed to identify *clinical* predictors for AF recurrences after catheter ablation [7,8]. Such clinical predictors as persistent AF and enlarged left atrial diameter have reproducibly been shown to associate with AF recurrences [9]. Also $CHADS_2$, CHA_2DS_2-VASc and R_2CHADS_2 scores were found to be significant predictors [7,10].

Coronary artery disease (CAD) is a significant risk factor for AF [11] but is understudied in the setting of AF catheter ablation. Several experimental studies demonstrated the relationship between chronic atrial ischemia and AF substrate [12,13]. In particular, right atrial ischemia induced by right coronary artery (RCA) disease has been shown to promote AF triggers and the substrate for AF maintenance [13]. To date, the presence and extent of CAD are usually not considered to tailor AF ablation strategies. In particular, *right atrial* ablation is not routinely being performed in patients with RCA disease. The aim of this study was to

☆ All authors take responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation.

* Corresponding author at: Heart Center, Department of Electrophysiology, Strümpellstr, 39, 04289 Leipzig, Germany.
E-mail address: jelena.kornej@gmx.de (J. Kornej).

http://dx.doi.org/10.1016/j.ijcard.2014.12.039
0167-5273/

Table 1
Baseline characteristics of the study population.

Variables n (%)	Study population n = 1310	CAD		p-Value
		No (n = 1158)	Yes (n = 152)	
Age, years	60 ± 10	59 ± 10	65 ± 8	<0.001
Females	434 (33)	397 (35)	30 (20)	<0.001
Persistent AF	480 (37)	416 (37)	53 (35)	0.681
BMI	29 ± 5	29 ± 5	29 ± 5	0.669
eGFR, ml/min/1.73 m^2	101 ± 32	103 ± 33	90 ± 30	<0.001
Hypertension	942 (72)	787 (70)	131 (86)	<0.001
Diabetes mellitus	210 (16)	166 (15)	39 (26)	0.001
PAD	104 (8)	76 (7)	23 (15)	0.013
Previous TE	97 (7)	80 (7)	16 (11)	0.271
EF, %	59 ± 10	59 ± 10	56 ± 12	0.001
LA diameter, mm	43 ± 6	42 ± 6	43 ± 6	0.637
CTI ablation	312 (24)	278 (24)	34 (22)	0.751
Linear LA ablation	491 (38)	430 (37)	61 (40)	0.362

Abbreviations: BMI — body mass index (kg/m^2), eGFR — estimated glomerular filtration rate (ml/min/1.73 m^2), PAD — peripheral artery disease, TE — thromboembolic events, EF — ejection fraction, LA — left atrial, CTI — cavotricuspid isthmus.

analyze the possible association between the presence and extent of CAD and rhythm outcomes of *left-atrial* AF catheter ablation in a large contemporary AF population.

2. Methods

2.1. Study population

1310 patients from The Leipzig Heart Center AF Ablation Registry undergoing *de novo* AF catheter ablation were included in this study (Table 1). All patients underwent AF catheter ablation according to current guidelines at our institution between January 2007 and December 2011. The study was performed according to the Declaration of Helsinki and Institutional Guidelines. Patients provided written informed consent.

Paroxysmal and persistent AF was defined according to current guidelines [3]. Paroxysmal AF was defined as self-terminating within 7 days after onset documented by previous routine electrocardiograms (ECG) or Holter ECG. Persistent AF was defined as any AF episode either lasting longer than 7 days or requiring drug or direct current cardioversion for termination. According to the current guidelines [14], coronary artery disease (CAD) was defined as a disease causing exercise- and stress-related chest symptoms due to narrowing of ≥50% in the left main coronary artery and ≥70% in one or several of the major coronary arteries. Patients with suspected CAD underwent stress test and catheterization before AF ablation. All patients from The Leipzig Heart Center AF Ablation Registry were checked for known CAD. If diagnosis of CAD was found, the presence and extent of CAD in each patient were proved by analysis of invasive coronary angiography.

In all patients, transthoracic and transesophageal echocardiography was performed prior to ablation. All class I or III antiarrhythmic medications with the exception of amiodarone were discontinued at least for 5 half-lives before the procedure.

2.2. Radiofrequency catheter ablation

Left atrial catheter ablation was performed using a well documented approach [15]. Patients presenting with AF at the beginning of the procedure were electrically cardioverted and ablation was performed during sinus rhythm (i.e. AF termination with ablation was not attempted). In all patients circumferential left atrial ablation lines were placed around the antrum of the ipsilateral pulmonary veins (irrigated tip catheter, pre-selected tip temperature of 48 °C, and maximum power of 30–50 W). In patients with persistent AF, additional linear lesions were added at the left atrial roof, the basal posterior wall and the left atrial isthmus. At the end of procedure, linear block was confirmed across the roof and the mitral isthmus. Ablation of complex fractionated electrocardiograms was not performed.

After circumferential line placement, voltage and pace mapping along the ablation line were used to identify and close gaps. The isolation of all pulmonary veins with bidirectional block was verified with a multipolar circular mapping catheter and was defined as the procedural endpoint. Ablation of the cavo-tricuspid isthmus (CTI) was performed if typical atrial flutter was documented or induced.

After ablation, class I and III antiarrhythmic drugs were not reinitiated, and proton pump inhibitors were added for 4 weeks. According to the current guidelines [3], oral anticoagulation was prescribed for 3–6 months after catheter ablation and depending on risk stratification of stroke using the CHA_2DS_2-VASc [16] score thereafter.

2.3. Follow-up

All patients were followed up in the outpatient clinic for 12 months after the catheter ablation. During this follow-up period, 7-day Holter recordings were performed (immediately, 3, 6 and 12 months after the ablation). Additional ECGs and Holter recordings were obtained when patients' symptoms were suggestive of AF. Early AF recurrences (ERAF) were defined as any atrial arrhythmia lasting longer than 30 s and occurring within the first week after procedure, which is in alignment with previous definitions [17,18]. This definition was also chosen because continuous Holter ECG monitoring was available for 98% patients for this time period. If recurrent AF was self-terminating within 24 h, no additional therapeutic measures were undertaken. In the case of sustained episodes, sinus rhythm was restored using external electrical cardioversion. If patients had very early recurrence before discharge, the antiarrhythmic therapy was continued for more than 1 month. Late AF recurrences (LRAF) were any atrial arrhythmia between 3 and 12 months after ablation. If electrical or pharmacological cardioversion and/or repeat procedure were needed after 3 months blanking period, this was considered as late AF recurrences, i.e. study endpoint.

2.4. Statistical analysis

Data are presented as means and standard deviation for normally distributed continuous variables and as proportions for categorical variables. Continuous variables were tested for normal distribution using the Kolmogorov–Smirnov test. The differences between continuous values were assessed using an unpaired two-tailed t-test for normally distributed continuous variables, a Mann–Whitney test for skewed variables, and a chi-square test for nominal variables.

Multivariable logistic regression analysis (MV) for ERAF and Cox regression analysis for LRAF, which included variables with a p-value < 0.1 found on univariable analysis, were performed to identify predictors for AF recurrences.

A p-value < 0.05 was considered as statistically significant. All statistical analyses were performed with SPSS statistical software version 17.

Table 2
Clinical and echocardiographic characteristics associated with early AF recurrences.

Variables	UV			MV			MV[a]		
	OR	95% CI	p-Value	OR	95% CI	p-Value	OR	95% CI	p-Value
Age, years	1.021	1.009–1.033	<0.001	1.014	0.996–1.031	0.119	1.015	0.997–1.033	0.096
Males	0.779	0.615–0.987	0.039	0.810	0.612–1.073	0.142	0.822	0.619–1.092	0.177
Persistent AF	1.643	1.303–2.073	<0.001	1.485	1.136–1.943	0.004	1.502	1.159–1.947	0.002
BMI	1.017	0.995–1.040	0.131						
eGFR	0.996	0.992–1.000	0.026	0.998	0.993–1.003	0.369	0.997	0.992–1.003	0.340
Hypertension	1.263	0.979–1.628	0.072	1.117	0.832–1.501	0.461	1.130	0.840–1.521	0.418
Diabetes mellitus	1.225	0.906–1.656	0.188						
CAD	1.091	0.769–1.547	0.625				0.867	0.600–1.253	0.447
PAD	0.906	0.593–1.383	0.646						
Previous TE	1.117	0.732–1.704	0.607						
EF, %	0.993	0.981–1.005	0.251						
LA diameter, mm	1.032	1.012–1.052	0.002	1.026	1.004–1.049	0.020	1.027	1.005–1.049	0.015
CTI ablation	0.685	0.528–0.889	0.004	0.663	0.449–0.881	0.005	0.658	0.497–0.872	0.004
Linear LA ablation	1.441	1.142–1.817	0.002	1.057	0.804–1.390	0.690	1.059	0.803–1.395	0.703

Abbreviations: as in Table 1. UV — univariable analysis, MV — multivariable analysis, BMI — body mass index, eGFR — estimated glomerular filtration rate, CAD — coronary artery disease, PAD — peripheral artery disease, TE — thromboembolic events, EF — ejection fraction, LA — left atrial.
[a] MV model adjusted for CAD.